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POPULATIONS AND HOST PREFERENCES OF JUNE BEETLES (PHYLLOPHAGA SPP.)
IN SOUTHERN WISCONSIN IN 1941, WITH A SUMMARY OF SIMILAR INFORMATION
FOR THE PERIOD 1935-1941, INCLUSIVE

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The study of the flights, populations, and host preferences of June beetles in southern Wisconsin has been continued since 1934. Accounts of the flights of 1935-37, inclusive, of 1938, and of 1940 were given in the Insect Pest Survey Bulletin, Supplement to No. 4, Volume 18; Supplement to No. 3, Volume 19; and Supplement to No. 9, Volume 20, respectively. Methods of study, flight habits, and temperature reactions of the beetles are discussed in some detail in those reports. The work was completed as a major project in 1941; consequently this report includes a summary of the results for the 7-year period, as well as a more detailed account for the year 1941.

STUDIES IN 1941

In the 1941 studies eight main groves were used, in addition to a few others from which supplementary collections were made. Seven of the 8 groves had been used previously. They were located near the following towns or villages: Poynette and Leeds, Columbia County; Ripon, Fond du Lac County; Dane, Dane County; Lamont, Lafayette County; Linden, Iowa County; and Gays Mills, Crawford County. The eighth grove was near Wisconsin Rapids, Wood County. The location of these groves is shown in figure 1. As formerly, the Gays Mills area, which was studied more intensively than any of the others, is considered separately, whereas the other areas are grouped. Twelve flight observations were made at Gays Mills between April 26 and July 1, and 13 in other areas between April 30 and June 18. All beetles collected were hand-picked from their host plants.

Numbers and Species of Beetles Collected

In the Gays Mills area 12 species of Phyllophaga were taken, which, in a decreasing order of abundance, were as follows: Phyllophaga rugosa (Melsh), P. fusca (Froel.), P. hirticula (Knoch), P. balia (Say), P. ilicis (Knoch), P. tristis (F.), P. prunina Lec., P. implicita Horn, P. marginalis (Lec.), P. drakei (Kby.), P. nitida (Lec.), and P. inversa (Horn). P. rugosa, P. fusca, and P. hirticula comprised 56.64 percent, 28.14 percent, and 7.65 percent, respectively, of the total beetles taken, and altogether made up 92.43 percent of the total. The number of beetles of each species may be found in table 1.

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Table 1. June beetles taken from host plants in 1941

Species	At Gays Mills	From areas other than Gays Mills	Total
	Number	Number	Number
<i>P. hirticula</i>	192	1,986	2,178
<i>P. fusca</i>	706	1,342	2,048
<i>P. rugosa</i>	1,421	540	1,961
<i>P. balia</i>	122	12	134
<i>P. ilicis</i>	48	49	97
<i>P. tristis</i>	10	77	87
<i>P. futilis</i>	0	32	32
<i>P. drakei</i>	1	31	32
<i>P. nitida</i>	1	30	31
<i>P. implicita</i>	2	28	30
<i>P. prunina</i>	3	25	28
<i>P. marginalis</i>	2	10	12
<i>P. crenulata</i>	0	21	21
<i>P. anxia</i>	0	11	11
<i>P. inversa</i>	1	0	1
Total	2,509	4,194	6,703

From areas other than Gays Mills, 14 species were taken. These included 11 of the 12 species collected at Gays Mills and 3 others--*Phyllophaga futilis* Lec., *P. crenulata* (Froel.), and *P. anxia* Lec. The most common species, in a diminishing order of abundance, were *P. hirticula*, *P. fusca*, *P. rugosa*, *P. tristis*, and *P. ilicis*. *P. hirticula*, *P. fusca*, and *P. rugosa* made up 47.35, 32.00, and 12.88 percent, respectively, of the total number of beetles taken, and altogether constituted 92.23 percent. The actual numbers of all species taken from areas outside the Gays Mills area, as well as the total numbers of beetles of each species taken in all areas, are given in table 1.

Host Preferences of the Beetles

In the Gays Mills area *Phyllophaga rugosa* was collected from 22 kinds of plants, 9 of which yielded 86.34 percent of the total. *P. fusca* was taken from 20 kinds of plants, 4 of which yielded 86.68 percent of the total. *P. hirticula* was taken from 10 kinds of plants, 4 of which supplied 89.58 percent of the total. *P. balia* was also taken from 10 kinds of plants, 4 of which gave 86.69 percent of the total. *P. ilicis* was taken from 9 kinds of plants, 5 of which supplied 85.42 percent of the total. The principal hosts of these species and the percentage of the total furnished by each are given in table 2.

Table 2. Beetles taken from various host plants in Gays Mills area in 1941

Host plant	<i>P. rugosa</i>		<i>P. fusca</i>		<i>P. hirticula</i>		<i>P. balia</i>		<i>P. ilicis</i>	
	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent	Num-ber	Per-cent
Cherry (cult.) ...	382	26.88	55	7.79	33	17.19	--	--	5	10.42
Butternut	189	13.30	362	51.27	73	38.02	19	15.57	14	29.17
Hazel	144	10.13	33	4.67	37	19.27	--	--	13	27.08
Hickory	131	9.22	162	22.95	29	15.10	74	60.66	5	10.42
Elm	114	8.02	--	--	--	--	--	--	--	--
<i>Crataegus</i> spp. ...	102	7.18	--	--	--	--	7	5.74	4	8.33
<i>Populus grandidentata</i>	60	4.22	--	--	--	--	--	--	--	--
<i>Populus tremuloides</i> (aspen) ..	58	4.08	--	--	--	--	--	--	--	--
Basswood	47	3.31	--	--	--	--	--	--	--	--
Wild crab (<i>Pyrus</i>) ..	--	--	--	--	--	--	6	4.92	--	--
Total	1,227	86.34	612	86.68	172	89.58	106	86.89	41	85.42

A complete list of all hosts of all species collected at Gays Mills, with various other data, is given in table 3. This table is similar to the complete tables in the reports previously cited. There are three entries in each space, which, reading from the top, consist of a percentage, a number, and a percentage. The top percentage represents the percentage of the beetles of the species named at the head of the column, taken from the host plant at the left, the middle figure the number of beetles of the species taken from the host at the left, and the percentage at the bottom of the space the percentage of the total beetles from the host at the left supplied by the species at the head of the column. Thus, 13.30 percent of the beetles of the species *Phyllophaga rugosa* were taken from butternut. The number of beetles of this species from butternut was 189, and the number of *P. rugosa* beetles from this host represented 28.64 percent of the total beetles of all species from this host.

In areas outside of the Gays Mills district, *Phyllophaga hirticula* was collected from 16 kinds of plants. Four of these supplied 90.03 percent of the total beetles of this species. *P. fusca* was collected from 17 kinds of plants, of which 7 supplied 92.78 percent of the total. *P. rugosa* was taken from 18 kinds of plants, 86.67 percent being supplied by 6 kinds. *P. tristis* was taken from 4 kinds of plants, 98.71 percent being supplied by 3 of them. *P. ilicis* was collected from 5 kinds of plants, of which 2 supplied 91.83 percent of the total. *P. futilis* was found on 8 kinds of plants, 4 of which supplied 87.51 percent of the total beetles. A list of the principal hosts of these more important species is given in table 4.

Table 4. Beetles taken from host plants outside of Gays Mills area in 1941

Host plant	P.hirticula		P.fusca		P.rugosa		P.tristis		P.ilicis		P.futilis	
	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent
Hazel....	1353	68.13	95	7.08	140	25.93	--	--	42	85.71	18	56.25
Bur oak .	314	15.81	158	11.77	27	5.00	57	74.03	3	6.12	3	9.38
Red oak group .	64	3.22	164	12.22	66	12.22	9	11.69	--	--	--	--
Aspen ...	57	2.87	130	9.69	140	25.93	--	--	--	--	--	--
Dogwood .	--	--	515	38.38	48	8.89	--	--	--	--	--	--
Hickory .	--	--	97	7.23	47	8.70	--	--	--	--	--	--
White oak	--	--	86	6.41	--	--	10	12.99	--	--	--	--
Elm	--	--	--	--	--	--	--	--	--	--	5	15.63
Raspberry	--	--	--	--	--	--	--	--	--	--	2	6.25
Total .	1788	90.03	1245	92.78	468	86.67	76	98.71	45	91.83	28	87.51

In table 5 are listed all species collected, with their hosts, in the same way the species are listed for the Gays Mills area in table 3.

Summary of Populations and Host Preferences of the
Principal Species from 1935 to 1941, Inclusive

During the 7-year period 1935-41, inclusive, collections were made from 28 groves which, with 1 exception, were in the southern half of the State. The location of these groves is shown in figure 2. June beetles (according to the listing in the tables as they appear in the reports mentioned) were collected from 69 kinds of host plants, the identity of 4 being uncertain. Oaks of the red oak group, and occasionally other closely related plants, were not separated as to species, owing to difficulty in making accurate determinations at night; therefore, over 70 species are actually represented. A total of 56,344 beetles were collected. The most common beetles for the 7-year period were as follows:

Species	Number	Percent
P. rugosa	19,354	34.35)
P. hirticula	17,785	31.57) 87.93
P. fusca	12,402	22.01)
P. implicita	1,651	2.93
P. tristis	1,185	2.10
P. ilicis	1,097	1.95
Total	53,474	94.91

TABLE 3
Beetles Collected in the Gays Mills Area, 1941

Hosts	P.rugosa	P.fusca	P.hirticula	P.balia	P.ilicis	P.tristis	P.pruni	P.impunctata	P.marginalis	P.inversa	P.nitida	P.drakii	Totals
	33.30%	51.27%	38.02%	15.57%	29.17%	10.00%	66.67%						28.31%
	169	562	73	19	14	1	2						880
Butternut	28.64%	54.85%	11.06%	2.89%	2.12%	.15%	.80%						100.00%
	28.85%	7.79%	17.19%	.82%	10.42%			50.00%			100.00%		19.05%
Cherry	382	55	53	1	6			1			1		478
(Cultivated)	79.92%	11.61%	8.90%	.21%	1.05%			.21%			.21%		100.01%
	9.22%	22.96%	15.10%	60.88%	10.42%	10.00%			50.00%		100.00%		15.10%
Hickory	131	182	29	74	5	1			1		1		404
	52.43%	40.10%	7.18%	16.32%	1.24%	.25%			.25%		.25%		100.02%
	10.13%	4.67%	19.27%	4.92%	27.08%	20.00%			50.00%				9.41%
Hasel	144	53	57	6	13	2			1				238
	61.02%	13.95%	15.85%	2.54%	5.51%	.85%			.42%				100.00%
	7.15%	3.82%	4.85%	5.74%	8.33%								5.84%
Crataegus	102	27	9	7	4								149
	88.46%	16.12%	6.04%	4.70%	2.88%								100.00%
	8.02%	.67%		2.46%				50.00%					4.86%
Elm	114	4		3				1					122
Populus	98.44%	3.25%		2.46%				.82%					100.00%
(grandi)	4.22%	.25%											2.47%
dentata)	80	2											82
	96.77%	3.23%											100.00%
	3.31%	1.42%	.82%		4.17%								2.55%
Basswood	47	10	1		2								60
	79.33%	16.67%	1.67%		3.33%								100.00%
	4.05%		.52%										2.35%
Aspen	53		1										54
	98.31%		1.69%										100.00%
	1.67%	2.69%		.82%	2.08%	50.00%							1.91%
White Oak	24	19		1	1	3							48
	50.00%	39.58%		2.08%	2.08%	6.25%							98.99%
	3.10%	.25%	.82%					35.53%					1.91%
Willow	44	2	1					1					48
	91.87%	4.17%	2.08%					2.08%					100.00%
	1.85%	.25%	3.13%	5.28%	6.25%								1.63%
Ironwood	26	2	6	4	3								41
	63.41%	4.88%	14.63%	9.78%	7.32%								100.00%
	1.65%	.57%											1.12%
Poplar	24	4											28
	85.71%	14.29%											100.00%
	1.06%	.85%	1.04%	.82%		20.00%				100.00%			1.08%
Red Oak	15	6	2	1		2				1			27
(Group)	55.56%	22.22%	7.41%	3.70%		7.41%				3.70%			100.00%
	1.83%					10.00%							1.08%
Apple	28					1							27
(Cultivated)	96.30%					3.70%							100.00%
	1.85%	.25%											.95%
Box Elder	22	2											24
	91.67%	8.33%											100.00%
	.35%	.57%				2.08%							.40%
Raspberry	5	4			1								10
	50.00%	40.00%			10.00%								100.00%
	.07%	.42%		4.92%									.40%
Wild Crab	1	3		6									10
(Pyrus)	10.00%	30.00%		80.00%									100.00%
		.57%											.16%
Ash		4											4
		100.00%											100.00%
	.21%												.12%
Sumac	3												3
	100.00%												100.00%
		.28%											.08%
Dogwood		2											2
		100.00%											100.00%
		.28%											.0%
Plum (Wild)		2											2
		100.00%											100.00%
	.14%												.08%
Cherry (Choke)	2												2
	100.00%												100.00%
		.14%											.04%
Thistle		1											1
(Full)		100.00%											100.00%
	.07%												.04%
Mint	1												1
	100.00%												100.00%
	.07%												.04%
Sp.?	1												1
	100.00%												100.00%
	99.98%	99.98%	100.00%	100.01%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.00%	100.01%
Totals	1421	706	192	122	46	10	3	2	2	1	1	1	2509
	56.84%	28.14%	7.65%	4.88%	1.91%	.40%	.12%	.08%	.08%	.04%	.04%	.04%	100.00%



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The number given for Phyllophaga tristis in this list is too small, for the reason that this species feeds extensively on the high parts of large oak trees, largely to the exclusion of other plants, and in 1936, when there was a tremendous flight of this species and extremely small flights of the others, their relative abundance could not be ascertained. The number given was derived from collections from low shrubs and trees in groves where other species were present. The data should be fairly accurate, however, if the year 1936 is not considered.

The other beetles collected, listed in a descending order of populations, consisted of the following species: Phyllophaga prunina, P. drakei, P. balia, P. futilis, P. nitida, P. crenulata, P. anxia, P. marginalis, P. spreta (Horn), P. inversa, P. fosteri (Burm.), P. vilifrons (Lec.), and P. sp.?, making a total of 18 determined and 1 undetermined species.

The chief host plants of June beetles in general are given in table 6, and the chief host plants of the principal species in table 7. An examination of table 6 shows definitely the importance of hazel brush, bur oak, and hickory as food for the beetles and indicates that if destruction of any considerable portion of the principal species of June beetles is attempted by spraying, the low shrub, hazel, must be sprayed in addition to the trees. Where protection of valuable trees or shrubs is the objective, rather than materially reducing the numbers of adults and grubs in any considerable area, spraying is effective.

Table 6.—Chief host plants of all species of June beetles collected, 1935-41

Host plant	Beetles collected	
	Number	Percentage of total
Hazel.....	12,173	21.60
Bur oak.....	8,105	14.38
Hickory.....	5,247	9.31
Cherry (cultivated).....	4,731	8.40
Populus spp., mostly aspen...	4,677	8.30
Red oak group.....	4,122	7.32
Butternut.....	3,971	7.05
Dogwood.....	3,252	5.77
Willow.....	2,186	3.88
White oak.....	1,334	2.37
Total.....	49,798	88.38

Table 7.--Chief hosts of principal species of June beetles collected 1935-41, with percentage of each species collected from plants named

Host plant	P. rugosa		P. hirticula		P. fusca		P. implicita		P. tristis		P. ilicis		P. futilis	
	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent	Num- ber	Per- cent
Cherry (cult.).....	3,523	18.20	--	--	1,066	8.60	--	--	--	--	31	2.83	--	--
Hickory.....	2,474	12.73	1,297	7.29	1,136	9.16	--	--	--	--	139	12.67	--	--
Butternut.....	2,023	10.52	--	--	1,444	11.61	--	--	--	--	221	20.15	--	--
Hazel.....	1,929	9.97	8,077	45.41	856	6.90	--	--	--	--	462	42.11	137	34.86
Populus spp. mostly aspen.....	1,884	9.73	--	--	1,408	11.35	742	44.94	--	--	--	--	--	--
Willow.....	1,147	5.93	--	--	--	--	788	47.73	--	--	--	--	--	--
Red oak group.....	1,098	5.67	731	4.11	1,194	9.63	--	--	273	23.04	--	--	--	--
Bur oak.....	906	4.68	5,097	28.66	1,321	10.65	--	--	715	60.34	--	--	9	2.29
Basswood.....	706	3.65	--	--	--	--	--	--	--	--	--	--	11	2.80
Elm.....	636	3.29	--	--	--	--	--	--	--	--	--	--	32	8.14
Dogwood.....	--	--	--	--	2,343	18.89	--	--	--	--	--	--	20	5.09
White oak.....	--	--	--	--	--	--	--	--	53	4.47	--	--	--	--
Ironwood.....	--	--	--	--	--	--	--	--	--	--	38	3.46	--	--
Prickly ash.....	--	--	--	--	--	--	--	--	--	--	--	--	42	*10.69
Plum(cult.).....	--	--	--	--	--	--	--	--	--	--	--	--	20	5.09
Rose (wild).....	--	--	--	--	--	--	--	--	--	--	--	--	18	4.58
Raspberry.....	--	--	--	--	--	--	--	--	--	--	--	--	16	4.09
Plum (wild).....	--	--	--	--	--	--	--	--	--	--	--	--	13	3.31
Gooseberry.....	--	--	--	--	--	--	--	--	--	--	--	--	9	2.29
Locust.....	--	--	--	--	--	--	--	--	--	--	--	--	9	2.29
Total.....	16,326	84.42	15,202	85.47	10,770	86.79	1,530	92.67	1,041	87.85	891	81.22	336	85.42

* In the Blue Mounds grove, where both hazel and prickly ash (Xanthoxylum americanum) are abundant, prickly ash appears to be the preferred host.

TABLE 5
Beetles Collected in Southern Wisconsin Outside of Gays Mills Area, 1941

Hosts	P.hir- ticola	P.fusca	P.rugosa	P.tristis	P.ilicis	P.futillis	P.drakii	P.nitida	P.impli- cita	P.prunina	P.orenu- lata	P.balia	P.anxia	P.margi- nalis	Totals
	88.13% 1353 79.28%	7.08% 95 5.58%	25.98% 140 8.20%		85.71% 42 2.46%	58.25% 16 1.05%	51.81% 16 .94%	48.67% 14 .83%	10.71% 3 .18%	32.00% 6 .47%	61.90% 13 .78%	6.55% 1 .08%	18.18% 2 .12%	20.00% 2 .12%	40.70% 1707 100.01%
Hazel	.56% 10 1.87%	38.35% 515 85.98%	8.89% 48 8.01%		2.04% 1 .17%	3.15% 1 .17%	25.81% 6 1.34%	28.67% 6 1.34%			4.78% 1 .17%	25.00% 3 .50%	9.09% 1 .17%	30.00% 3 .50%	14.28% 599 100.02%
Dogwood	15.81% 314 54.99%	11.77% 158 27.67%	5.00% 27 4.75%	74.03% 57 9.98%	8.12% 3 .53%	9.38% 3 .53%	3.23% 1 .18%	6.67% 2 .35%				50.00% 6 1.05%			13.81% 571 100.01%
Bur Oak	2.37% 57 16.10%	9.89% 130 36.72%	25.93% 140 39.56%		4.08% 2 .68%				78.57% 22 6.21%				18.18% 2 .56%	10.00% 1 .28%	8.44% 321 99.98%
Aspen	3.22% 64 19.84%	12.22% 164 51.09%	12.22% 66 20.56%	11.69% 8 2.80%			9.65% 3 .95%	8.67% 2 .62%		40.00% 10 3.12%				30.00% 3 .93%	7.66% 321 99.99%
Red Oak (Group)	1.98% 37 22.29%	8.41% 86 51.81%	4.81% 28 15.66%	12.59% 10 6.02%						20.00% 5 3.01%		8.33% 1 .60%		10.00% 1 .60%	3.98% 186 99.99%
White Oak	1.01% 20 12.12%	7.23% 97 56.79%	8.70% 47 28.48%									8.33% 1 .61%			5.93% 165 100.00%
Hickory	3.02% 60 88.24%	.07% 1 1.47%	1.11% 6 8.82%		2.04% 1 1.47%										1.82% 68 100.00%
Crataegus sp.	.10% 2 4.55%	2.63% 34 77.27%	1.11% 6 13.84%	1.50% 1 2.27%		5.13% 1 2.27%									1.05% 44 100.00%
Plum (Wild)	.56% 19 44.19%	.87% 9 20.93%	.56% 3 6.98%			15.65% 5 11.65%			10.71% 3 6.98%				38.36% 4 9.30%		1.03% 43 100.01%
Elm	1.01% 20 51.28%	1.12% 15 38.45%				8.25% 2 5.13%		8.67% 2 5.13%							.93% 39 100.00%
Raspberry	.55% 11 28.21%	1.12% 15 38.45%	2.41% 13 33.33%												.93% 39 100.00%
Butternut	.10% 2 10.53%	.97% 13 86.42%	.74% 4 21.05%												.45% 19 100.00%
Bitternut	.45% 9 50.00%	.30% 4 22.22%	.19% 1 5.56%					3.33% 1 5.56%			14.28% 3 18.87%				.45% 16 100.01%
Rose (Wild)	.20% 4 50.00%	.74% 4 50.00%													.15% 8 100.00%
Willow							6.45% 2 33.33%				19.05% 4 66.67%				100.00%
Blueberry	.20% 4 80.00%	.18% 1 20.00%													.12% 6 100.00%
Cherry (Choke)		.07% 1 20.00%	.37% 2 40.00%							8.00% 2 40.00%					.12% 5 100.00%
Blackberry (Wild)			.74% 4 100.00%												.10% 4 100.00%
Box Elder		.22% 3 100.00%													.07% 3 100.00%
Woodbine		.15% 2 100.00%													.05% 2 100.00%
Gooseberry													18.18% 2 100.00%		.05% 2 100.00%
Basswood			.37% 2 100.00%												.05% 2 100.00%
Grape (Wild)						3.15% 1 100.00%									.02% 1 100.00%
Apple						3.15% 1 100.00%									.02% 1 100.00%
Grass (Undetermined)							3.25% 1 100.00%								.02% 1 100.00%
Thorny Shrub (Undetermined)								3.33% 1 100.00%							.02% 1 100.00%
Weed (Undetermined)															.02% 1 100.00%
Totals	99.99% 1986 47.85%	100.00% 1342 32.00%	100.01% 540 12.68%	100.01% 77 1.84%	99.98% 49 1.17%	100.08% 32 .76%	100.01% 31 .74%	100.01% 30 .72%	99.99% 26 .67%	100.00% 25 .60%	100.00% 21 .50%	99.99% 12 .29%	99.99% 11 .26%	100.00% 10 .24%	99.99% 4194 100.02%

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It would appear from table 7 that control of adults by spraying would not be generally effective for Phyllophaga rugosa, P. fusca, and P. futilis, which have 10, 8, and 12 principal hosts, respectively. In the case of P. hirticula, P. tristis, and P. ilicis, better results might be obtained, because these species concentrate their feeding on fewer kinds of plants. The species of grubs most common in cereal and forage crops, however, have been P. rugosa, P. hirticula, and P. fusca. Grubs of P. tristis and P. futilis occasionally have been numerous in these crops in some localities. P. ilicis grubs have not been found in the field.

In considering the data in tables 6 and 7, it should be borne in mind that while these data show clearly the kinds of plants preferred by various species of June beetles for food, they are not an entirely accurate measure of the importance of the various plants as hosts in all localities. For example, in large areas where Phyllophaga hirticula is numerous, the host plant bur oak is more abundant than is hazel, and individual plants furnish much more foliage to be fed upon than do individual hazel plants. In regard to cultivated cherry, which supplied many of the P. rugosa and P. fusca beetles collected, this plant can be important only in those limited areas in which it is grown commercially.

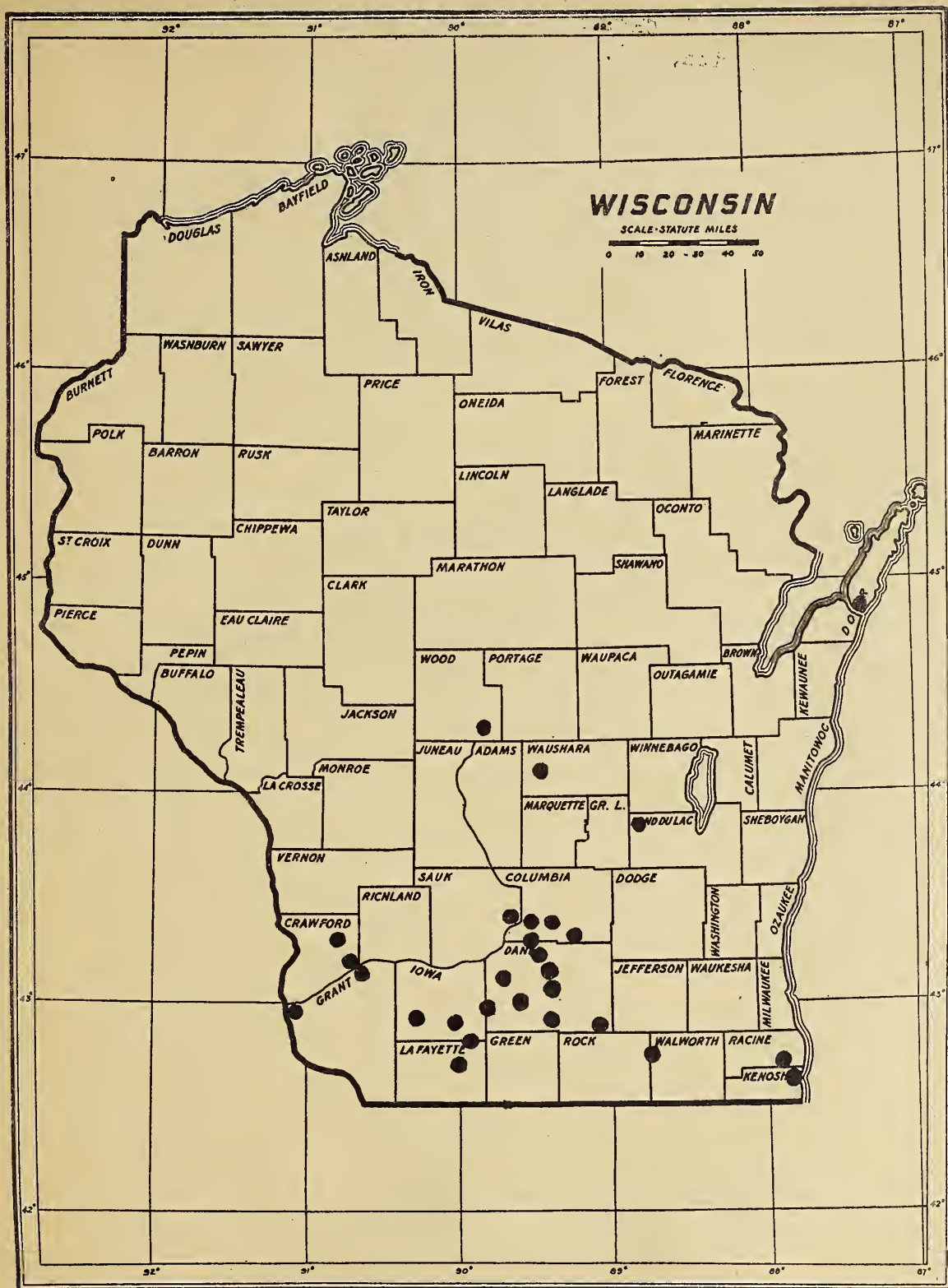


Figure 2.--Localities in which flight studies and collections were made during the period 1935-41, inclusive.

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